

Lesson 2



Making a surfboard

From Natural Resource to Store Shelf

In this lesson, students begin to explore the ways people use natural resources. They return to *California Connections: A Surfboard Story* and describe the material and energy resources used in processing and manufacturing surfboards in more detail. Through the lesson, students learn the purpose and components of a design blueprint and study the decision-making process that designers follow in choosing the materials that go into finished products.

As part of the lesson's activity, students act as designers and make choices about the manufacturing of a surfboard, weighing the advantages and disadvantages of using differ-

ent materials. They consider effects of their choices on the surfers (in the board's performance), the surfboard company, and the environment. Finally, students apply this informa-

tion to their individual unit projects as they develop an initial blueprint for the toy they decided to design in Lesson 1.

Learning Objective

Explain the methods used to make common objects (useable products) from natural resources.



Regardless of an object's design, the manufacturing process requires energy and raw materials from natural systems. Some of these resources go into the products; others go into building and running the machines that process resources for products. An estimated average of only 5% of all natural resources involved in producing and transporting products make their way into a final object.

Manufacturing companies face many choices about the types of materials they use, the way they extract and harvest resources, how they process resources, and how they dispose of waste. Factors such as cost, availability, durability, efficiency, and consumer demand influence the choices made at every stage of production. The decisions companies make have the potential to alter natural systems and affect human health.

Background

The manufacturing and design process often follows a predictable pattern. Based on a perceived consumer need, manufacturers develop preliminary or functional designs for products. They sketch or form models of these initial designs. As they analyze and refine their designs, product developers continue to perfect more refined models, either from technical sketches or their original primitive models. Later in the design process they must focus on the scale of their models as well as the materials that will be needed in the final product.

Although the Industrial Revolution brought about significant changes in the production of objects in many parts of the world, for the most part the stages of the design process remain the same. Even as fuel-powered engines, machines, and factories replaced manual labor and artisan work, object designers continued to follow the same creative engineering and analysis steps. Over time technology has allowed designers to conduct more in-depth analyses of their preliminary designs. The opening of global markets has also increased the number and amount of raw materials available to designers.



Blueprint review

Key Vocabulary

Blueprint: A technical drawing showing a plan or how to do something.

Design: (verb) To plan or make something in a skillful or artistic way. **(noun)** A drawing or model that shows how something is to look, be made, or how it works.

Factory: The facility where people and machines manufacture objects.

Production: The process of manufacturing something.

Toolbox



Summary of Activities

Students discuss the design process and evaluate different raw material options and the factors involved making decisions about materials for manufacturing. They make a design blueprint of their toys and indicate the materials they will use for each part.



Instructional Support

See Unit Resources, page 28

Prerequisite Knowledge



Students should know about:

- natural resources (materials and energy).
- the physical properties of common materials.

Students should have:

- completed previous lesson.

Advanced Preparation



Gather and prepare Activity Masters:

- Gather from previous lessons:
 - *California Connections:*
A Surfboard Story from Lesson 1
 - *Manufacturing and Design Journals* (individual student's copies)

Gather and prepare Visual Aids:

- Prepare transparencies.



Materials Needed



A-V equipment:

- Overhead projector or LCD projector, screen

Class supplies:

- Markers, crayons, colored pencils, rulers

Visual Aids



Transparencies:

- Surfboard Design Blueprint #1, Visual Aid #5
- Surfboard Design Blueprint #2, Visual Aid #6

Duration



Preparation Time

20 min.

Instructional Time

60 min.



Safety Notes

None

Activity Masters in the Supporting Materials (SM)

Surfing the Choices

SM, Page 16
One per student

Procedures

Step 1

In the middle of the white board, draw a circle and label it “surfboard factory.” Ask students, “What words come to mind when you picture a surfboard factory?” As students share their thoughts, write each word around the outside of the circle. Explain that a factory is a place where objects—such as surfboards—are manufactured. Tell students that another word for “manufacturing” is “production.”

Step 2

Redistribute *California Connections: A Surfboard Story* (Lesson 1 Activity Master) to each student. Finish reading the story, focusing on the section entitled “Meanwhile, Back at the Surfboard Sandwich.” Ask students, “How do the people at the factory know how to put the surfboard together?” (*They follow a plan created by the surfboard designer.*)

Explain that designers are people who decide how to make objects. They choose which materials to use and how to put those materials together. Designers have to think about durability, appearance, cost, and safety of the materials they choose.

Step 3

Project the transparency of the **Surfboard Design Blueprint #1** (Visual Aid #5). Ask students, “What information is given in the blueprint?” (*Measurements, parts and general shape*) Explain that the designers first draw a picture or make a model of the object they want to create.

Tell the class that after making the first drawing or model, the designer then considers which materials to use for each piece of the object. Project the transparency of the **Surfboard Design Blueprint #2** (Visual Aid #6) and have students study the information on this new blueprint, which shows the materials for each component of the surfboard. Ask students, “What do you think the designers have to think about when deciding which material to use for each part of the object?” (*What that part has to do, what materials do that, what the cost of the material might be, whether the material is available or not, whether the material is safe to use.*) Tell students that the more expensive the materials used, the more expensive the final surfboard will be for surfboard shoppers.

Step 4

Distribute **Surfing the Choices** (Lesson 2 Activity Master) to each student. Leave **Surfboard Design Blueprint #2** on the projector and have the class read through the material choices on **Surfing the Choices**. Follow along and indicate on the projector the part of the surfboard being discussed. [*Blank (deck, nose, and tail), stringer, and fins.*]

When the class has read through the material choices, have students make their design selections. Have students share their choices and their rationales. For each choice shared, point out which factors the students considered in deciding which materials to use. (*Cost, performance or properties, natural resource category or type*)

Step 5

Distribute student **Manufacturing and Design Journals** (individual student’s copies) and the rulers, markers, crayons, and colored pencils. Have students turn to and read the directions on pages 8–9 (Toy Design Blueprint). With **Surfboard Design Blueprint #2** still on the projector, tell students to refer to the visual aid for help in making their own blueprints using the supplies you distributed. Students should also refer to pages 4–5 (Origins Chart) in their journals for helpful information on raw materials and their uses in manufacturing.

Step 6

Give students the rest of the class period and homework time to complete their design blueprints. Have students place their copies of *California Connections: A Surfboard Story*, and **Surfing the Choices** in their journals. Collect the journals with the completed blueprints for use in assessment.



Lesson Assessment

Description

This lesson introduces students to the design stage of the manufacturing process, including decision-making about materials. After working as a class to identify goods from natural systems that could go into the components of a surfboard and to understand the considerations that designers make about each part, students complete pages 8–9 (Toy Design Blueprint) in their **Manufacturing and Design Journal** (individual student's copies). In this step they create a design blueprint of the toy they chose to create in Lesson 1; they identify its main parts and indicating their choice(s) of raw materials for use in each part.

Scoring Rubric

Score	Performance
5	Student shows more than one view of the toy, indicates and labels three or more major parts, and lists two or more raw materials or natural resources to be used for each part.
4	Student shows one detailed view of the toy, indicates and labels three or more major parts, and lists two or more raw materials or natural resources to be used for each part.
3	Student shows one view of the toy, indicates and labels three or more major parts, and lists one or two raw materials or natural resources to be used for each part.
2	Student shows one view of the toy, indicates and labels fewer than three parts, and/or lists only one raw material or natural resource to be used for each part.
1	Student draws the toy, but does not label parts or identify raw materials or natural resources.

Suggested Scoring

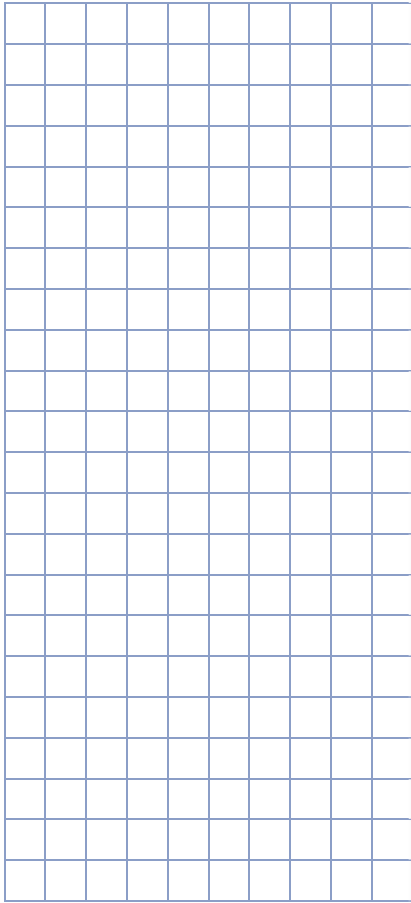
The rubric below can be used to score student design blueprints. Student diagrams should include all visible parts, identified with arrows and labels. Lists of the chosen materials for each part should be logical for each student's particular toy.

Toy Design Blueprint

Today's Task

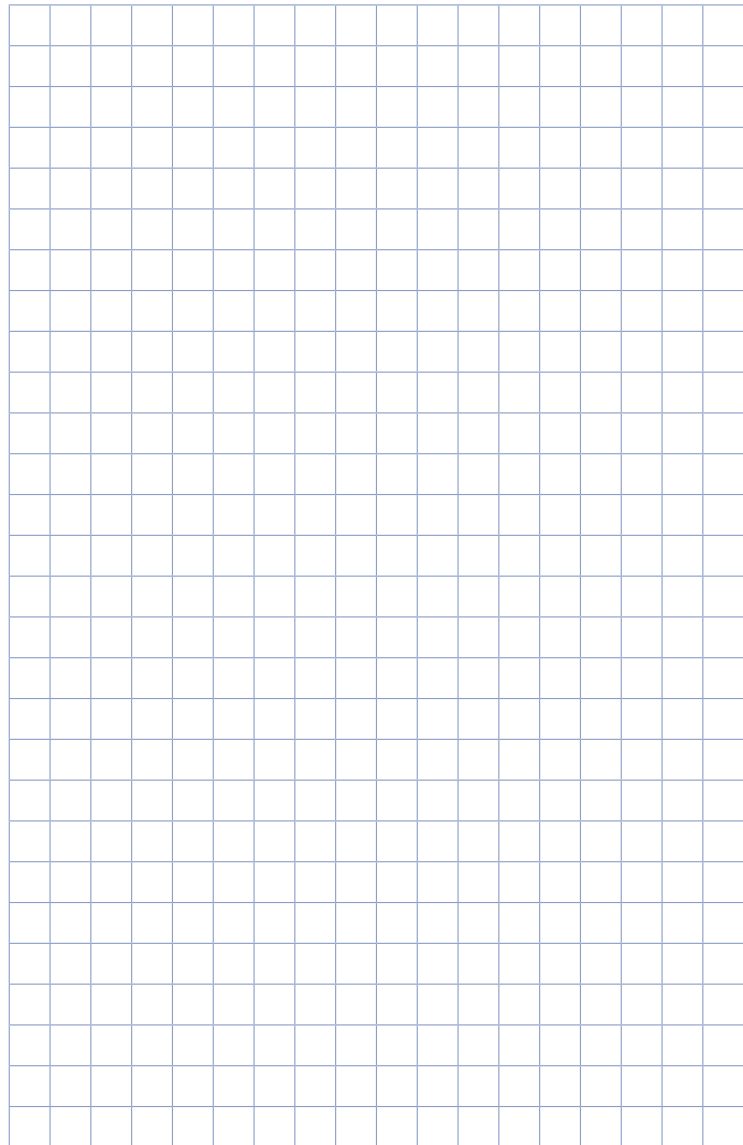
Create a blueprint for the toy you want to manufacture. Label the parts of your toy that and make a list of the material(s) you would like to use for each part. Draw two views of your toy.

Toy Name: _____



Manufacturing and Design Journal

Toy Design Blueprint



Manufacturing and Design Journal

Surfing the Choices

Lesson 2 Activity Master | page 1 of 2

Name: _____

1. Which material do you want to use for your surfboard *blank* (deck, nose and tail)? (Check one)

- _____ **Polyurethane foam:** Polyurethane foam is one of the easiest materials to shape. Decks made from polyurethane have a smooth finish, which surfers like. Polyurethane is also the least expensive of the materials used for the body of a surfboard. Polyurethane foam is made from petroleum, which is a fossil fuel.
- _____ **Polystyrene foam:** Polystyrene is used to make the foam cups you might get at take-out restaurants in some cities. It is one of the most lightweight options available for building surfboards, which means that surfboards made from polystyrene float well in the ocean. Some polystyrene absorbs a lot of water and polystyrene is not as strong as polyurethane foam. To make it stronger and more waterproof, manufacturers seal the outside of polystyrene blanks with fiberglass. But even a tiny hole in the fiberglass shell can ruin a surfboard. Polystyrene is also made from petroleum, a fossil fuel.
- _____ **Wood:** Wood comes from plants and is a renewable resource. In some types of well-managed forests, trees can grow back as fast as people cut them. Wood is strong and floats, but a wood surfboard is a lot heavier than one made of foam. According to some surfers, wood boards do not perform as well as foam boards. It can also be more expensive to make a surfboard out of wood than out of foam.
- _____ **Biofoam:** Biofoam is made from the sap of plants, which is renewable. This type of foam is easy to shape and has a smooth finish, but can vary in color and in how paint sticks to it. Biofoam can be mixed with polyurethane foam to make it stronger and more even in color.

2. Which material do you want to use for your surfboard *stringer*? (Check one)

- _____ **Wood:** Wood is a renewable resource with strength and flexibility, but it is expensive.
- _____ **Epoxy with fiberglass:** Epoxy is made from petroleum, like polystyrene foam. It is easy to cut. Fiberglass is made from glass threads. Petroleum is a fossil fuel and silica, which goes into the glass, is a mineral ore. Both are less expensive and lighter in weight than wood.

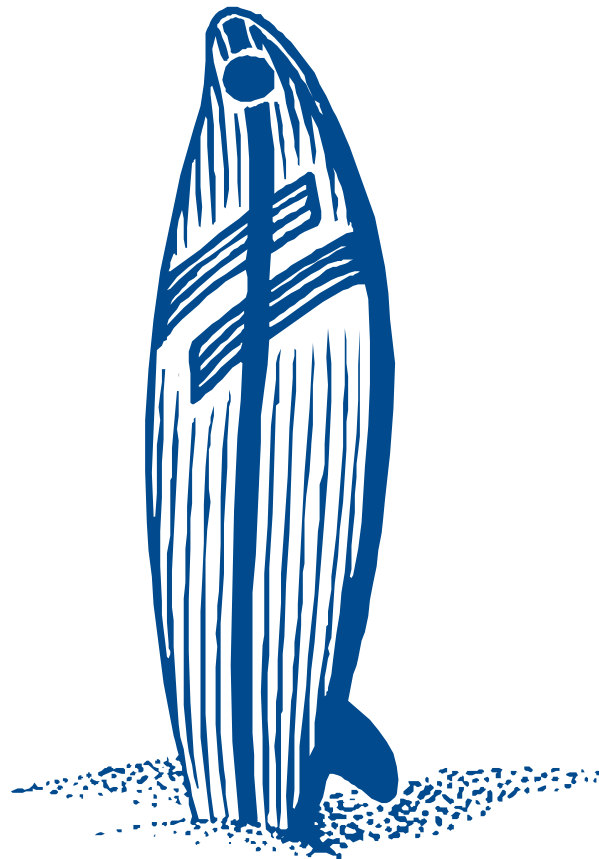
Surfing the Choices

Lesson 2 Activity Master | page 2 of 2

Name: _____

3. Which material do you want to use for your surfboard *fin(s)*? (Check one.)

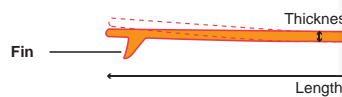
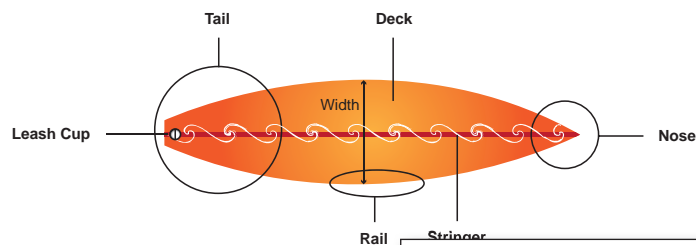
- _____ **Epoxy:** Manufacturers pour petroleum-based epoxy resin into molds and let it harden. Epoxy fins are lightweight and inexpensive.
- _____ **Fiberglass:** In fiberglass fins, layers of cloth made from glass thread are criss-crossed and pressed together. Fiberglass fins are strong.
- _____ **Carbon:** This material is actually graphite, a mineral ore. Manufacturers mold it into shape for lightweight, strong, and flexible fins, which bend but do not break.
- _____ **Aluminum:** Manufacturers form threads of aluminum (made from the mineral ore bauxite) into a cloth and sandwich cloth layers together for thickness and strength. Aluminum is the lightest material used in making fins.



5

Surfboard Design Blueprint #1
Visual Aid — Transparency

Surfboard Design Blueprint #1



6

Surfboard Design Blueprint #2
Visual Aid — Transparency

Surfboard Design Blueprint #2

